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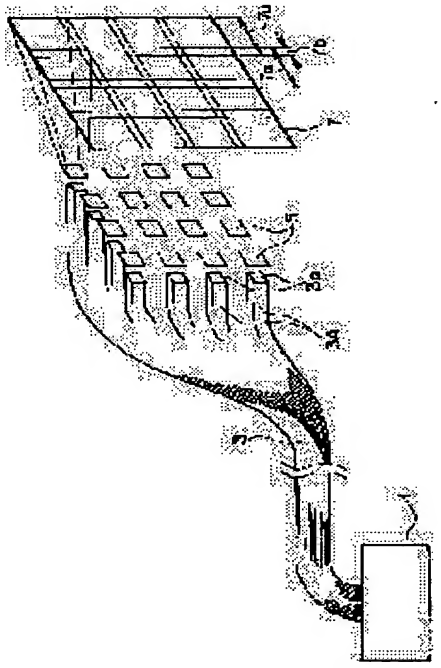
(54) IMAGE DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an image display device which can uniformly illuminate each display element and can display a high quality image.
SOLUTION: The image display device illuminates m-piece display elements 5 (m is an integer equal to or more than two) with an illuminator, projects images on a screen 7 with a projection optical system, and forms one image by compositing each image. The illuminator has a lamp unit 1 which houses a lamp as a light source, and a fiber bundle 3 which transmits light from the lamp to m-piece display elements 5. The emission side of the fiber bundle 3 is branched to m-bundle emission side subbundles 3A corresponding to the m- piece display elements 5, respectively, and an emission end 3a is formed in each subbundle 3A, and then illuminating light is illuminated from each exiting end 3a towards each opposite display element 5.



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CLAIMS

[Claim(s)]
[Claim 1] The display device of m (m is two or more integers) individual, and a lighting means to illuminate these display devices, The projection optics which projects on a screen the image of the display device illuminated by this lighting means, It is the image display device which constitutes one image by providing and combining the image by the m above-mentioned display devices. The above-mentioned lighting means It comes to have the light source and the fiber bundle which transmits the light from this light source to the m above-mentioned display devices. This fiber bundle The image display device characterized by branching to the each outgoing radiation side [m bundles] subbundle corresponding to the m above-mentioned display devices, and forming an outgoing radiation edge in each of these outgoing radiation side subbundles in the outgoing radiation side.
[Claim 2] The above-mentioned light source n (n is two or more integers) **** eclipse ****** and the above-mentioned fiber bundle In the incidence side, it branches to the each incidence side [n bundles] subbundle corresponding to the n above-mentioned light sources. The fiber which the incidence edge is formed in each of these incidence side subbundles, and constitutes each incidence side subbundle is an image display device according to claim 1 characterized by being equally assigned by the outgoing radiation side [the m above-mentioned bundles] subbundle.
[Claim 3] The image display device according to claim 1 with which outgoing radiation side optical system for irradiating and laying the light by which outgoing radiation is carried out on top of the whole screen of the above-mentioned display device from the outgoing radiation edge of each fiber which constitutes this outgoing radiation side subbundle from an outgoing radiation edge of an outgoing radiation side [the m above-mentioned bundles] subbundle on each optical path which results in the m above-mentioned display devices is characterized by being each arranged.
[Claim 4] The image display device according to claim 1 characterized by arranging the incidence side optical system for irradiating the light by which outgoing radiation is respectively carried out to the lens array which forms two or more secondary light source images from the light of the above-mentioned light source from secondary light source images of these plurality all over the incidence edge of the above-mentioned fiber bundle, and piling it up from the above-mentioned light source on the optical path which reaches the incidence edge of an incidence side subbundle, and **.
[Claim 5] The above-mentioned fiber bundle is an image display device according to claim 2 characterized by arranging the glass rod of this fiber bundle and ****** at least in one side by the side of the incidence and outgoing radiation.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to an image display device and the image display device which constitutes one image by combining the image by two or more display devices in more detail.
[0002]
[Description of the Prior Art] In case a partial image is displayed by two or more display devices and these partial images are projected on a screen, as for the image display device which constitutes one image, various things are conventionally proposed by projecting so that adjoining partial images may pile up with a superposition field at the side edge mutually, and combining the partial image of these plurality.
[0003] As an example of such an image display device, to JP,9-211412,A In the multi-image display device equipped with the screen which compounds and displays the partial image generated from two or more projection units which generate the partial image which constitutes some images, and two or more above-mentioned projection units The above-mentioned screen consists of two or more partial Fresnel lenses prepared corresponding to two or more projection units, and one diffusion plate containing a diffusion material, and the multi-image display device which provided the tooth space of fixed length between two or more above-mentioned partial Fresnel lenses and a diffusion plate is indicated.
[0004] Moreover, two or more liquid crystal modules which generate the partial image which equips JP,9-159985,A with a liquid crystal panel, and constitutes some images, The screen which displays the partial image generated from two or more above-mentioned liquid crystal modules, The optical feed zone which supplies light to the liquid crystal panel of two or more above-mentioned liquid crystal modules, It **** and the image display system equipped with two or more fiber optic cables with which this optical feed zone distributes the light emitted from at least one light source which emits light to two or more liquid crystal modules, and this at least one light source to two or more above-mentioned liquid crystal modules is indicated.
[0005]
[Problem(s) to be Solved by the Invention] Since such an image display device is what constitutes one image combining the partial image by two or more display devices as mentioned above, it must be made for a difference of a brightness difference or a color not to generate it in each partial image projected on a screen. However, since a different illumination-light faculty for every display device is used with a technique which was indicated by above-mentioned JP,9-211412,A, it is not easy to arrange the brightness and color for every partial image with homogeneity.
[0006] Moreover, with a technique which was indicated by above-mentioned JP,9-159985,A, when breakage etc. arises in an optical fiber, nonuniformity will arise for the lighting to a display device.
[0007] Then, a technique in which such uniform lighting is comparatively realizable for low cost is desired.
[0008] This invention is made in view of the above-mentioned situation, and it aims at offering

the image display device which can illuminate each display device to homogeneity and can display a quality image.
[0009]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the image display device by the 1st invention The display device of m (m is two or more integers) individual, and a lighting means to illuminate these display devices, The projection optics which projects on a screen the image of the display device illuminated by this lighting means, It is the image display device which constitutes one image by providing and combining the image by the m above-mentioned display devices. The above-mentioned lighting means It comes to have the light source and the fiber bundle which transmits the light from this light source to the m above-mentioned display devices. This fiber bundle In the outgoing radiation side, it branches to the each outgoing radiation side [m bundles] subbundle corresponding to the m above-mentioned display devices, and an outgoing radiation edge is formed in each of these outgoing radiation side subbundles.
[0010] In the image display device according [the image display device by the 2nd invention] to the 1st above-mentioned invention the above-mentioned light source moreover, n (n is two or more integers) **** eclipse ****** and the above-mentioned fiber bundle In the incidence side, the fiber which it branches to the each incidence side [n bundles] subbundle corresponding to the n above-mentioned light sources, and the incidence edge is formed in each of these incidence side subbundles, and constitutes each incidence side subbundle is equally assigned by the outgoing radiation side [the m above-mentioned bundles] subbundle.
[0011] Furthermore, outgoing radiation side optical system for the image display device by the 3rd invention to irradiate and lay the light by which outgoing radiation is carried out on top of the whole screen of the above-mentioned display device from the outgoing radiation edge of each fiber which constitutes this outgoing radiation side subbundle from an outgoing radiation edge of an outgoing radiation side [the m above-mentioned bundles] subbundle in the image display device by the 1st above-mentioned invention on each optical path which results in the m above-mentioned display devices is each arranged.
[0012] And the image display device by the 4th invention is set to the image display device by the 1st above-mentioned invention. The lens array which forms two or more secondary light source images from the light of the above-mentioned light source on the optical path from the above-mentioned light source to the incidence edge of an incidence side subbundle, The incidence side optical system for irradiating the light by which outgoing radiation is carried out respectively all over the incidence edge of the above-mentioned fiber bundle, and piling it up from secondary light source images of these plurality, and ** are arranged.
[0013] In addition, in the image display device according [the image display device by the 5th invention] to the 2nd above-mentioned invention, the glass rod of this fiber bundle and ****** is arranged at least in one side by the side of the incidence and outgoing radiation for the above-mentioned fiber bundle.
[0014]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing. Drawing in which drawing 7 shows the 1st operation gestalt of this invention from drawing 1 , and drawing 1 shows the configuration of an image display device, The perspective view showing the example [in / in drawing 2 / the lighting system of an image display device] of 1 configuration of a lamp and a fiber bundle, The perspective view showing other examples [in / in drawing 3 / the lighting system of an image display device] of a configuration of a lamp and a fiber bundle, Drawing showing the situation of arrangement of a fiber [in / in drawing 4 / the configuration of above-mentioned drawing 3], drawing showing the configuration of incidence side optical system [in / in drawing 5 / a lighting system], drawing showing the configuration of outgoing radiation side optical system [in / in drawing 6 / a lighting system], and drawing 7 are drawings showing the array of each fiber in the outgoing radiation edge of an outgoing radiation side subbundle.
[0015] As this image display device is shown in drawing 1 , the light which emitted light within the lamp unit 1 is transmitted with the fiber bundle 3. The display device 5 which becomes with

the transparency mold LCD of plurality (they are 16 pieces at the example shown in this drawing 1) etc. is irradiated, and one image consists of projecting partial image 7a by this display device 5 on a screen 7 so that it may have superposition field 7b mutually at that side edge as a whole.
[0016] The example of 1 configuration of the above-mentioned fiber bundle 3 is explained with reference to drawing 2 .
[0017] This drawing 2 is an example of a configuration in case one light source slack lamp 1a is arranged in the lamp unit 1.
[0018] The fiber bundle 3 bundles two or more fiber 3f (reference, such as drawing 4), is constituted, carries out incidence of the light of incidence edge 3b to the above-mentioned lamp 1a of incidence side 3B, and transmits it by each fiber 3f.
[0019] The outgoing radiation side of this fiber bundle 3 has branched to outgoing radiation side subbundle 3A of the same number as the number of the above-mentioned display device 5, fiber 3f of an equal number is arranged and outgoing radiation edge 3a for carrying out outgoing radiation of the transmitted light is further prepared in each outgoing radiation side subbundle 3A at each outgoing radiation side subbundle 3A, respectively.
[0020] Thus, since the light of the same lamp was distributed and each display device was illuminated by constituting, there is neither brightness of lighting nor dispersion of a color, and one image constituted with each partial image on which it was projected by the screen 7 was unified as a whole.
[0021] Next, other examples of a configuration of the above-mentioned fiber bundle 3 are explained with reference to drawing 3 .
[0022] This drawing 3 is an example of a configuration in case two or more arrangement of the light source slack lamp 1b is carried out into the lamp unit 1.
[0023] The incidence side of the fiber bundle 3 has branched to incidence side subbundle 3C of the same number as the number of lamp 1b, fiber 3f of an equal number is arranged and incidence edge 3c for carrying out incidence of the light from this lamp 1b is further prepared in each incidence side subbundle 3C at each incidence side subbundle 3C, respectively.
[0024] Moreover, about the outgoing radiation side of the fiber bundle 3, it is the same as that of what was shown in above-mentioned drawing 2 .
[0025] The arrangement of fiber 3f in the fiber bundle 3 as shown in this drawing 3 is further explained with reference to drawing 4 .
[0026] When the number of n pieces (n is two or more integers) and a display device 5 is made into m pieces (m is two or more integers) for the number of the above-mentioned lamp 1b, incidence side subbundle 3C will have each branched [n bundles and outgoing radiation side subbundle 3A] to m bundles.
[0027] Supposing each incidence side subbundle 3C is constituted by p fiber 3f at this time, these branch to every [p/m] and are each distributed to outgoing radiation side subbundle 3A prepared m bundles.
[0028] In this way, from all incidence side subbundle 3C, the light by which incidence is carried out is equally assigned to each outgoing radiation side subbundle 3A, and is transmitted to it, and it is constituted so that outgoing radiation of the light of the same quantity of light may be carried out from any outgoing radiation side subbundle 3A.
[0029] Thus, even if any of two or more lamp 1b they are stops lighting up with constituting further in addition to the effectiveness acquired with the configuration of above-mentioned drawing 2 , some images do not become dark and the brightness of the whole image becomes possible [observing an image succeedingly only in the condition of falling a little]. [it]
[0030] Moreover, since the number of lamp 1b can be easily changed at the time of a design, it becomes easy to fluctuate the quantity of light to a request, and it also becomes possible to prolong the life of the lamp itself compared with obtaining the large quantity of light with a single lamp.
[0031] Next, with reference to drawing 5 , the configuration of the incidence side optical system in the lighting system as a lighting means is explained.
[0032] The configuration shown in this drawing 5 is applied to all of the incidence side optical system arranged on the optical path which results in incidence edge 3c of lamp 1b to the

incidence side optical system arranged on the optical path from above-mentioned lamp 1a to incidence edge 3b of incidence side 3B of the fiber bundle 3, or incidence side subbundle 3C.
[0033] That is, incidence of the light by which outgoing radiation was carried out from the above-mentioned lamps 1a and 1b is carried out to the integrator lens 11 which becomes by the grid-like lens array, and it forms two or more secondary light source images.
[0034] This secondary light source image is projected by incidence edge 3b of incidence side 3B of the fiber bundle 3, or incidence edge 3c of incidence side subbundle 3C according to the incidence side optical system of the Koehler illumination optical system which consists of a superposition lens 12 and a condensing lens 13.
[0035] more — detailed — two or more secondary light source images — respectively — since — the light by which outgoing radiation is carried out — any — although — the light from all secondary light source images will be overlapped, and will be irradiated by each fiber 3f all that irradiated all over the incidence edges 3b and 3c, that is, have been exposed at the incidence edges 3b and 3c. Thereby, since it becomes the same, the quantity of light which each fiber 3f transmits becomes possible [it becoming unnecessary to recognize and distribute fiber 3f according to an individual, and distributing to an outgoing radiation side only by the number].
[0036] Then, with reference to drawing 6 , the configuration of the outgoing radiation side optical system in the lighting system as a lighting means is explained.
[0037] The outgoing radiation side optical system shown in this drawing 6 is arranged on the optical path from outgoing radiation edge 3a of the above-mentioned outgoing radiation side subbundle 3A to a display device 5.
[0038] That is, the light by which outgoing radiation is carried out from outgoing radiation edge 3a of outgoing radiation side subbundle 3A is irradiated by the outgoing radiation side optical system of the Koehler illumination optical system which consists of a superposition lens 15 and a condensing lens 16 at the whole screen of a display device 5. Thereby, the screen of a display device 5 is illuminated by homogeneity in the whole field, without the luminance distribution of light and darkness arising.
[0039] In this way, the image of the illuminated display device 5 is projected towards the above-mentioned screen 7 by the projection optics 18 which consists of lens 18a and lens 18b.
[0040] Moreover, in outgoing radiation edge 3a of outgoing radiation side subbundle 3A, each fiber 3f, as shown in drawing 7 , it is arranged.
[0041] That is, while converging two or more fiber 3f according to the configuration of the screen of the display device 5 which presents the shape of a rectangle so that the whole profile may present the shape of an abbreviation rectangle, fiber 3f is arranged so that an equilateral-triangle-like grid may be made.
[0042] in this way, the fiber train on a par with the horizontal direction of drawing 7 — even level and odd level — this — about half a horizontal array — ******** — it is like. When the flux of light concerning superposition field 7b of the partial image on which a display device 5 is illuminated with two or more light sources or secondary light source images, and it is projected from this display device 5 is shaded using a gobo etc. Although it may originate in the array of the above-mentioned light source or secondary light source images and stair-like luminance distribution may occur at the side edge of a partial image, the luminance distribution of the shape of this stairway is mitigated, and it enables it to obtain a smooth brightness change curve by performing the array which shifted the phase as shown in this drawing 7 .
[0043] According to such 1st operation gestalt, since the light of a lamp is equally distributed to each display device, it becomes possible for neither the brightness for every display device nor dispersion of a color to occur, and to display a quality image.
[0044] Moreover, when arranging two or more lamps to an incidence side, even if some out of which become possible [adjusting the change in the quantity of light easily], in addition it all does not come of two or more lamps stop lighting up, the part which is not illuminated by the screen does not occur.
[0045] Furthermore, in order that the light by which outgoing radiation is carried out may be irradiated by the whole screen of a display device and may pile up from each fiber, even if breakage etc. occurs they to be [any of two or more fibers], it is possible for the unevenness

of the luminance distribution on the screen of a display device not to occur, and to illuminate the whole screen uniformly.
[0046] And two or more secondary light source images can be formed from the light of a lamp, incidence of the uniform light can be carried out to each fiber which constitutes a fiber bundle to write so that the light by which outgoing radiation is respectively carried out from secondary light source images of these plurality may be irradiated all over the incidence edge of a fiber bundle and may be piled up, and the more uniform lighting of a display device is attained.
[0047] Drawing in which drawing 10's showing the 2nd operation gestalt of this invention from drawing 8 , and showing the configuration of incidence side optical system [in / in drawing 8 / a lighting system], drawing showing the configuration of outgoing radiation side optical system [in / in drawing 9 / a lighting system], and drawing 10 are the perspective views showing the configuration of the glass rod arranged in the outgoing radiation side of a fiber bundle.
[0048] In this 2nd operation gestalt, the sign same about the same part as the 1st above-mentioned operation gestalt is attached, explanation is omitted, and only a mainly different point is explained.
[0049] The incidence side optical system in the lighting system of this 2nd operation gestalt is constituted as shown in drawing 8 , and the glass rod 22 which has predetermined die length in the optical transfer direction is arranged in the incidence side of the fiber bundle 3.
[0050] That is, it is condensed with a lens 21 and incidence of the light by which outgoing radiation was carried out from the above-mentioned lamps 1a and 1b is carried out to a glass rod 22.
[0051] Although this light passes through the interior of this glass rod 22, according to the incident angle of a beam of light, total reflection of multiple times is performed inside at this time, and after a beam of light is mixed up and the optical reinforcement within a field perpendicular to the direction of an optical axis is equalized, incidence of it is carried out to the fiber bundle 3.
[0052] Thus, in order to form a glass rod 22 and to carry out the multiple echo of the beam of light in the interior, the luminous intensity by which outgoing radiation is carried out from Lamps 1a and 1b is equalized without the nonuniformity within a field, and can make 3f carry out incidence of the light of the same quantity of light to each fiber which constitutes incidence side of the fiber bundle 3 3B, or incidence side subbundle 3C.
[0053] Next, the outgoing radiation side optical system in the lighting system of this operation gestalt is constituted as shown in drawing 9 , and the glass rod 25 which has predetermined die length in the optical transfer direction is arranged in the outgoing radiation side of the fiber bundle 3.
[0054] Here, the above-mentioned glass rod 25 is formed in the rectangular parallelepiped configurations of this outgoing radiation side subbundle 3A and ****** according to the configuration of outgoing radiation side subbundle 3A which converges two or more fiber 3f in the shape of an abbreviation rectangle, and becomes, as shown in drawing 10 .
[0055] In such a configuration, although incidence is carried out to the continuing glass rod 25, according to the incident angle of a beam of light, total reflection of multiple times is performed inside at this time, and after a beam of light is mixed up and the optical reinforcement within a field perpendicular to the direction of an optical axis is equalized, outgoing radiation of the light transmitted in the fiber bundle 3 is carried out.
[0056] Thus, in order to form a glass rod 25 and to carry out the multiple echo of the beam of light in the interior, outgoing radiation of the nonuniformity of the optical reinforcement within a field perpendicular to the direction of outgoing radiation of the light transmitted in the fiber bundle 3 can be equalized and carried out.
[0057] Therefore, the nonuniformity within a field of the optical reinforcement resulting from the difference in the luminance distribution of a difference and lamp 1a of the brightness of two or more lamp 1b by the side of incidence, and the 1b itself or the crease to fiber 3f which constitutes the fiber bundle 3, and ** can be eliminated.
[0058] The light by which outgoing radiation was carried out from the above-mentioned glass rod 25 is irradiated by the display device 5 with the 1st lens 26 and 2nd lens 27 after that. Here,

these 1st lenses 26 and the 2nd lens 27 constitute an illumination-light study system which carries out image formation of the outgoing radiation side of the above-mentioned glass rod 25 on a display device 5 (critical illumination).
[0059] It can illuminate uniformly, without transforming the nonuniformity which may be produced in the angular distribution of the luminous intensity by which outgoing radiation is carried out from the fiber bundle 3 to the nonuniformity within a field on a display device 5 by this illumination.
[0060] In this way, after removing the nonuniformity of the light of the fiber bundle 3 on the strength [within a field] by using a glass rod 25, the illumination-light study system which becomes with the 1st lens 26 and 2nd lens 27 removes the nonuniformity on the strength in the angular distribution of the light by which outgoing radiation is carried out by the critical illumination method.
[0061] While the light of a lamp is reflected in an incidence side within a glass rod while doing so the almost same effectiveness as the 1st operation gestalt mentioned above according to such 2nd operation gestalt, and equalizing, lighting without nonuniformity can be performed by reflecting in an outgoing radiation side the light transmitted with the fiber bundle 3 within a glass rod, and equalizing.
[0062] Furthermore, since critical illumination which carries out image formation of the outgoing radiation side of a glass rod to an outgoing radiation side on a display device is performed, the nonuniformity of the illumination light on a display device is cancelable.
[0063] In addition, as for this invention, it is needless to say for various deformation and application to be possible within limits which are not limited to the operation gestalt mentioned above and do not deviate from the main point of invention.
[0064]
[Effect of the Invention] As explained above, since according to the image display device of this invention by claim 1 the outgoing radiation side of a fiber bundle was branched to the each outgoing radiation side [m bundles] subbundle corresponding to m display devices and the outgoing radiation edge was formed in each of these outgoing radiation side subbundles, brightness and a color vary and each display device is illuminated to homogeneity that there is nothing, and it becomes possible to display a quality image.
[0065] Moreover, while doing so the same effectiveness as invention according to claim 1 according to the image display device of this invention by claim 2 While branching the incidence side of a fiber bundle to the each incidence side [n bundles] subbundle corresponding to the n light sources and forming an incidence edge in each of these incidence side subbundles Since the fiber which constitutes each incidence side subbundle was equally assigned to the outgoing radiation side [the m above-mentioned bundles] subbundle Even if it is possible to make the quantity of light increase easily and one or the plurality which all does not come out of the n light sources disappears, a non-illuminating part does not occur on a screen and observation of an image can be continued.
[0066] Furthermore, while doing so the same effectiveness as invention according to claim 1 according to the image display device of this invention by claim 3 Since the outgoing radiation side optical system for irradiating and laying the light by which outgoing radiation is carried out on top of the whole screen of a display device from the outgoing radiation edge of each fiber which constitutes an outgoing radiation side subbundle was established, even if breakage of a fiber etc. occurs, the luminance distribution on a display device side is uniformly maintainable.
[0067] And while doing so the same effectiveness as invention according to claim 1 according to the image display device of this invention by claim 4 Since the incidence side optical system for irradiating the light by which outgoing radiation is carried out respectively all over the incidence edge of a fiber bundle, and piling it up from the light of the light source from the lens array which forms two or more secondary light source images, and secondary light source images of these plurality was established It becomes possible to carry out incidence of the uniform light to a fiber bundle.
[0068] In addition, since according to the image display device of this invention by claim 5 the nonuniformity within a field of the luminous intensity from a lighting means is equalized while

doing so the same effectiveness as invention according to claim 2, incidence of the light of the same quantity of light can be carried out to each fiber of a fiber bundle. Moreover, since the nonuniformity within a field of the luminous intensity from a fiber bundle is equalized, incidence of the light of the same quantity of light can be carried out to each display device.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] This invention relates to an image display device and the image display device which constitutes one image by combining the image by two or more display devices in more detail.

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PRIOR ART

[Description of the Prior Art] In case a partial image is displayed by two or more display devices and these partial images are projected on a screen, as for the image display device which constitutes one image, various things are conventionally proposed by projecting so that adjoining partial images may pile up with a superposition field at the side edge mutually, and combining the partial image of these plurality.
[0003] As an example of such an image display device, it is in JP,9-211412,A, In the multi-image display device equipped with the screen which compounds and displays the partial image generated from two or more projection units which generate the partial image which constitutes some images, and two or more above-mentioned projection units The above-mentioned screen consists of two or more partial Fresnel lenses prepared corresponding to two or more projection units, and one diffusion plate containing a diffusion material, and the multi-image display device which provided the tooth space of fixed length between two or more above-mentioned partial Fresnel lenses and a diffusion plate is indicated.
[0004] Moreover, two or more liquid crystal modules which generate the partial image which equips JP,9-159985,A with a liquid crystal panel, and constitutes some images, The screen which displays the partial image generated from two or more above-mentioned liquid crystal modules, The optical feed zone which supplies light to the liquid crystal panel of two or more above-mentioned liquid crystal modules, It **** and the image display system equipped with two or more fiber optic cables with which this optical feed zone distributes the light emitted from at least one light source which emits light to two or more liquid crystal modules, and this at least one light source to two or more above-mentioned liquid crystal modules is indicated.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, since according to the image display device of this invention by claim 1 the outgoing radiation side of a fiber bundle was branched to the each outgoing radiation side [m bundles] subbundle corresponding to m display devices and the outgoing radiation edge was formed in each of these outgoing radiation side subbundles, brightness and a color vary and each display device is illuminated to homogeneity that there is nothing, and it becomes possible to display a quality image.
[0065] Moreover, it is while doing so the same effectiveness as invention according to claim 1 according to the image display device of this invention by claim 2, While branching the incidence side of a fiber bundle to the each incidence side [n bundles] subbundle corresponding to the n light sources and forming an incidence edge in each of these incidence side subbundles Since the fiber which constitutes each incidence side subbundle was equally assigned to the outgoing radiation side [the m above-mentioned bundles] subbundle Even if it is possible to make the quantity of light increase easily and one or the plurality which all does not come out of the n light sources disappears, a non-illuminating part does not occur on a screen and observation of an image can be continued.
[0066] Furthermore, it is while doing so the same effectiveness as invention according to claim 1 according to the image display device of this invention by claim 3, Since the outgoing radiation side optical system for irradiating and laying the light by which outgoing radiation is carried out on top of the whole screen of a display device from the outgoing radiation edge of each fiber which constitutes an outgoing radiation side subbundle was established, even if breakage of a fiber etc. occurs, the luminance distribution on a display device side is uniformly maintainable.
[0067] And it is while doing so the same effectiveness as invention according to claim 1 according to the image display device of this invention by claim 4, Since the incidence side optical system for irradiating the light by which outgoing radiation is carried out respectively all over the incidence edge of a fiber bundle, and piling it up from the light of the light source from the lens array which forms two or more secondary light source images, and secondary light source images of these plurality was established, it becomes possible to carry out incidence of the uniform light to a fiber bundle.
[0068] In addition, since according to the image display device of this invention by claim 5 the nonuniformity within a field of the luminous intensity from a lighting means is equalized while doing so the same effectiveness as invention according to claim 2, incidence of the light of the same quantity of light can be carried out to each fiber of a fiber bundle. Moreover, since the nonuniformity within a field of the luminous intensity from a fiber bundle is equalized, incidence of the light of the same quantity of light can be carried out to each display device.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Since such an image display device is what constitutes one image combining the partial image by two or more display devices as mentioned above, it must be made for a difference of a brightness difference or a color not to generate it in each partial image projected on a screen. However, since a different illumination-light faculty for every display device is used with a technique which was indicated by above-mentioned JP,9-211412,A, it is not easy to arrange the brightness and color for every partial image with homogeneity.
[0006] Moreover, with a technique which was indicated by above-mentioned JP,9-159985,A, when breakage etc. arises in an optical fiber, nonuniformity will arise for the lighting to a display device.
[0007] Then, a technique in which such uniform lighting is comparatively realizable for low cost is desired.
[0008] This invention is made in view of the above-mentioned situation, and it aims at offering the image display device which can illuminate each display device to homogeneity and can display a quality image.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the image display device by the 1st invention The display device of m (m is two or more integers) individual, and a lighting means to illuminate these display devices, The projection optics which projects on a screen the image of the display device illuminated by this lighting means, It is the image display device which constitutes one image by providing and combining the image by the m above-mentioned display devices. The above-mentioned lighting means It comes to have the light source and the fiber bundle which transmits the light from this light source to the m above-mentioned display devices. This fiber bundle In the outgoing radiation side, it branches to the each outgoing radiation side [m bundles] subbundle corresponding to the m above-mentioned display devices, and an outgoing radiation edge is formed in each of these outgoing radiation side subbundles.
[0010] In the image display device according [the image display device by the 2nd invention] to the 1st above-mentioned invention the above-mentioned light source moreover, n (n is two or more integers) **** eclipse ****** and the above-mentioned fiber bundle In the incidence side, the fiber which it branches to the each incidence side [n bundles] subbundle corresponding to the n above-mentioned light sources, and the incidence edge is formed in each of these incidence side subbundles, and constitutes each incidence side subbundle is equally assigned by the outgoing radiation side [the m above-mentioned bundles] subbundle.
[0011] Furthermore, outgoing radiation side optical system for the image display device by the 3rd invention to irradiate and lay the light by which outgoing radiation is carried out on top of the whole screen of the above-mentioned display device from the outgoing radiation edge of each fiber which constitutes this outgoing radiation side subbundle from an outgoing radiation edge of an outgoing radiation side [the m above-mentioned bundles] subbundle in the image display device by the 1st above-mentioned invention on each optical path which results in the m above-mentioned display devices is each arranged.
[0012] And the image display device by the 4th invention is set to the image display device by the 1st above-mentioned invention. The lens array which forms two or more secondary light source images from the light of the above-mentioned light source on the optical path from the above-mentioned light source to the incidence edge of an incidence side subbundle, The incidence side optical system for irradiating the light by which outgoing radiation is carried out respectively all over the incidence edge of the above-mentioned fiber bundle, and piling it up from secondary light source images of these plurality, and ** are arranged.
[0013] In addition, in the image display device according [the image display device by the 5th invention] to the 2nd above-mentioned invention, the glass rod of this fiber bundle and ****** is arranged at least in one side by the side of the incidence and outgoing radiation for the above-mentioned fiber bundle.
[0014]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing. Drawing in which drawing 7 shows the 1st operation gestalt of this invention from drawing 1 , and drawing 1 shows the configuration of an image display device, The perspective view showing the example [in / in drawing 2 / the lighting system of an image

display device] of 1 configuration of a lamp and a fiber bundle, The perspective view showing other examples [in / in drawing 3 / the lighting system of an image display device] of a configuration of a lamp and a fiber bundle, Drawing showing the situation of arrangement of a fiber [in / in drawing 4 / the configuration of above-mentioned drawing 3], drawing showing the configuration of incidence side optical system [in / in drawing 5 / a lighting system], drawing showing the configuration of outgoing radiation side optical system [in / in drawing 6 / a lighting system], and drawing 7 are drawings showing the array of each fiber in the outgoing radiation edge of an outgoing radiation side subbundle.

[0015] As this image display device is shown in drawing 1 , the light which emitted light within the lamp unit 1 is transmitted with the fiber bundle 3. The display device 5 which becomes with the transparency mold LCD of plurality (they are 16 pieces at the example shown in this drawing 1) etc. is irradiated, and one image consists of projecting partial image 7a by this display device 5 on a screen 7 so that it may have superposition field 7b mutually at that side edge as a whole.

[0016] The example of 1 configuration of the above-mentioned fiber bundle 3 is explained with reference to drawing 2 .

[0017] This drawing 2 is an example of a configuration in case one light source slack lamp 1a is arranged in the lamp unit 1.

[0018] The fiber bundle 3 bundles two or more fiber 3f (reference, such as drawing 4), is constituted, carries out incidence of the light of incidence edge 3b to the above-mentioned lamp 1a of incidence side 3B, and transmits it by each fiber 3f.

[0019] The outgoing radiation side of this fiber bundle 3 has branched to outgoing radiation side subbundle 3A of the same number as the number of the above-mentioned display device 5, fiber 3f of an equal number is arranged and outgoing radiation edge 3a for carrying out outgoing radiation of the transmitted light is further prepared in each outgoing radiation side subbundle 3A at each outgoing radiation side subbundle 3A, respectively.

[0020] Thus, since the light of the same lamp was distributed and each display device was illuminated by constituting, there is neither brightness of lighting nor dispersion of a color, and one image constituted with each partial image on which it was projected by the screen 7 was unified as a whole.

[0021] Next, other examples of a configuration of the above-mentioned fiber bundle 3 are explained with reference to drawing 3 .

[0022] This drawing 3 is an example of a configuration in case two or more arrangement of the light source slack lamp 1b is carried out into the lamp unit 1.

[0023] The incidence side of the fiber bundle 3 has branched to incidence side subbundle 3C of the same number as the number of lamp 1b, fiber 3f of an equal number is arranged and incidence edge 3c for carrying out incidence of the light from this lamp 1b is further prepared in each incidence side subbundle 3C at each incidence side subbundle 3C, respectively.

[0024] Moreover, about the outgoing radiation side of the fiber bundle 3, it is the same as that of what was shown in above-mentioned drawing 2 .

[0025] The arrangement of fiber 3f in the fiber bundle 3 as shown in this drawing 3 is further explained with reference to drawing 4 .

[0026] When the number of n pieces (n is two or more integers) and a display device 5 is made into m pieces (m is two or more integers) for the number of the above-mentioned lamp 1b, incidence side subbundle 3C will have each branched [n bundles and outgoing radiation side subbundle 3A] to m bundles.

[0027] Supposing each incidence side subbundle 3C is constituted by p fiber 3f at this time, these branch to every [p/m] and are each distributed to outgoing radiation side subbundle 3A prepared m bundles.

[0028] In this way, from all incidence side subbundle 3C, the light by which incidence is carried out is equally assigned to each outgoing radiation side subbundle 3A, and is transmitted to it, and it is constituted so that outgoing radiation of the light of the same quantity of light may be carried out from any outgoing radiation side subbundle 3A.

[0029] Thus, even if any of two or more lamp 1b they are stops lighting up with constituting further in addition to the effectiveness acquired with the configuration of above-mentioned

drawing 2 , some images do not become dark and the brightness of the whole image becomes possible [observing an image succeedingly only in the condition of falling a little]. [it]
[0030] Moreover, since the number of lamp 1b can be easily changed at the time of a design, it becomes easy to fluctuate the quantity of light to a request, and it also becomes possible to prolong the life of the lamp itself compared with obtaining the large quantity of light with a single lamp.
[0031] Next, with reference to drawing 5 , the configuration of the incidence side optical system in the lighting system as a lighting means is explained.
[0032] The configuration shown in this drawing 5 is applied to all of the incidence side optical system arranged on the optical path which results in incidence edge 3c of lamp 1b to the incidence side optical system arranged on the optical path from above-mentioned lamp 1a to incidence edge 3b of incidence side 3B of the fiber bundle 3, or incidence side subbundle 3C.
[0033] That is, incidence of the light by which outgoing radiation was carried out from the above-mentioned lamps 1a and 1b is carried out to the integrator lens 11 which becomes by the grid-like lens array, and it forms two or more secondary light source images.
[0034] This secondary light source image is projected by incidence edge 3b of incidence side 3B of the fiber bundle 3, or incidence edge 3c of incidence side subbundle 3C according to the incidence side optical system of the Koehler illumination optical system which consists of a superposition lens 12 and a condensing lens 13.
[0035] more — detailed — two or more secondary light source images — respectively — since — the light by which outgoing radiation is carried out — any — although — the light from all secondary light source images will be overlapped, and will be irradiated by each fiber 3f all that irradiated all over the incidence edges 3b and 3c, that is, have been exposed at the incidence edges 3b and 3c. Thereby, since it becomes the same, the quantity of light which each fiber 3f transmits becomes possible [it becoming unnecessary to recognize and distribute fiber 3f according to an individual, and distributing to an outgoing radiation side only by the number].
[0036] Then, with reference to drawing 6 , the configuration of the outgoing radiation side optical system in the lighting system as a lighting means is explained.
[0037] The outgoing radiation side optical system shown in this drawing 6 is arranged on the optical path from outgoing radiation edge 3a of the above-mentioned outgoing radiation side subbundle 3A to a display device 5.
[0038] That is, the light by which outgoing radiation is carried out from outgoing radiation edge 3a of outgoing radiation side subbundle 3A is irradiated by the outgoing radiation side optical system of the Koehler illumination optical system which consists of a superposition lens 15 and a condensing lens 16 at the whole screen of a display device 5. Thereby, the screen of a display device 5 is illuminated by homogeneity in the whole field, without the luminance distribution of light and darkness arising.
[0039] In this way, the image of the illuminated display device 5 is projected towards the above-mentioned screen 7 by the projection optics 18 which consists of lens 18a and lens 18b.
[0040] Moreover, in outgoing radiation edge 3a of outgoing radiation side subbundle 3A, each fiber 3f, as shown in drawing 7 , it is arranged.
[0041] That is, while converging two or more fiber 3f according to the configuration of the screen of the display device 5 which presents the shape of a rectangle so that the whole profile may present the shape of an abbreviation rectangle, fiber 3f is arranged so that an equilateral-triangle-like grid may be made.
[0042] in this way, the fiber train on a par with the horizontal direction of drawing 7 — even level and odd level — this — about half a horizontal array — ******** — it is like. When the flux of light concerning superposition field 7b of the partial image on which a display device 5 is illuminated with two or more light sources or secondary light source images, and it is projected from this display device 5 is shaded using a gobo etc. Although it may originate in the array of the above-mentioned light source or secondary light source images and stair-like luminance distribution may occur at the side edge of a partial image, the luminance distribution of the shape of this stairway is mitigated, and it enables it to obtain a smooth brightness change curve by performing the array which shifted the phase as shown in this drawing 7 .

[0043] According to such 1st operation gestalt, since the light of a lamp is equally distributed to each display device, it becomes possible for neither the brightness for every display device nor dispersion of a color to occur, and to display a quality image.
[0044] Moreover, when arranging two or more lamps to an incidence side, even if some out of which become possible [adjusting the change in the quantity of light easily], in addition it all does not come of two or more lamps stop lighting up, the part which is not illuminated by the screen does not occur.
[0045] Furthermore, in order that the light by which outgoing radiation is carried out may be irradiated by the whole screen of a display device and may pile up from each fiber, even if breakage etc. occurs they to be [any of two or more fibers], it is possible for the unevenness of the luminance distribution on the screen of a display device not to occur, and to illuminate the whole screen uniformly.
[0046] And two or more secondary light source images can be formed from the light of a lamp, incidence of the uniform light can be carried out to each fiber which constitutes a fiber bundle to write so that the light by which outgoing radiation is respectively carried out from secondary light source images of these plurality may be irradiated all over the incidence edge of a fiber bundle and may be piled up, and the more uniform lighting of a display device is attained.
[0047] Drawing in which drawing 10's showing the 2nd operation gestalt of this invention from drawing 8 , and showing the configuration of incidence side optical system [in / in drawing 8 / a lighting system], drawing showing the configuration of outgoing radiation side optical system [in / in drawing 9 / a lighting system], and drawing 10 are the perspective views showing the configuration of the glass rod arranged in the outgoing radiation side of a fiber bundle.
[0048] In this 2nd operation gestalt, the sign same about the same part as the 1st above-mentioned operation gestalt is attached, explanation is omitted, and only a mainly different point is explained.
[0049] The incidence side optical system in the lighting system of this 2nd operation gestalt is constituted as shown in drawing 8 , and the glass rod 22 which has predetermined die length in the optical transfer direction is arranged in the incidence side of the fiber bundle 3.
[0050] That is, it is condensed with a lens 21 and incidence of the light by which outgoing radiation was carried out from the above-mentioned lamps 1a and 1b is carried out to a glass rod 22.
[0051] Although this light passes through the interior of this glass rod 22, according to the incident angle of a beam of light, total reflection of multiple times is performed inside at this time, and after a beam of light is mixed up and the optical reinforcement within a field perpendicular to the direction of an optical axis is equalized, incidence of it is carried out to the fiber bundle 3.
[0052] Thus, in order to form a glass rod 22 and to carry out the multiple echo of the beam of light in the interior, the luminous intensity by which outgoing radiation is carried out from Lamps 1a and 1b is equalized without the nonuniformity within a field, and can make 3f carry out incidence of the light of the same quantity of light to each fiber which constitutes incidence side of the fiber bundle 3 3B, or incidence side subbundle 3C.
[0053] Next, the outgoing radiation side optical system in the lighting system of this operation gestalt is constituted as shown in drawing 9 , and the glass rod 25 which has predetermined die length in the optical transfer direction is arranged in the outgoing radiation side of the fiber bundle 3.
[0054] Here, the above-mentioned glass rod 25 is formed in the rectangular parallelepiped configurations of this outgoing radiation side subbundle 3A and ****** according to the configuration of outgoing radiation side subbundle 3A which converges two or more fiber 3f in the shape of an abbreviation rectangle, and becomes, as shown in drawing 10 .
[0055] In such a configuration, although incidence is carried out to the continuing glass rod 25, according to the incident angle of a beam of light, total reflection of multiple times is performed inside at this time, and after a beam of light is mixed up and the optical reinforcement within a field perpendicular to the direction of an optical axis is equalized, outgoing radiation of the light transmitted in the fiber bundle 3 is carried out.

[0056] Thus, in order to form a glass rod 25 and to carry out the multiple echo of the beam of light in the interior, outgoing radiation of the nonuniformity of the optical reinforcement within a field perpendicular to the direction of outgoing radiation of the light transmitted in the fiber bundle 3 can be equalized and carried out.
[0057] Therefore, the nonuniformity within a field of the optical reinforcement resulting from the difference in the luminance distribution of a difference and lamp 1a of the brightness of two or more lamp 1b by the side of incidence, and the 1b itself or the crease to fiber 3f which constitutes the fiber bundle 3, and ** can be eliminated.
[0058] The light by which outgoing radiation was carried out from the above-mentioned glass rod 25 is irradiated by the display device 5 with the 1st lens 26 and 2nd lens 27 after that. Here, these 1st lenses 26 and the 2nd lens 27 constitute an illumination-light study system which carries out image formation of the outgoing radiation side of the above-mentioned glass rod 25 on a display device 5 (critical illumination).
[0059] It can illuminate uniformly, without transforming the nonuniformity which may be produced in the angular distribution of the luminous intensity by which outgoing radiation is carried out from the fiber bundle 3 to the nonuniformity within a field on a display device 5 by this illumination.
[0060] In this way, after removing the nonuniformity of the light of the fiber bundle 3 on the strength [within a field] by using a glass rod 25, the illumination-light study system which becomes with the 1st lens 26 and 2nd lens 27 removes the nonuniformity on the strength in the angular distribution of the light by which outgoing radiation is carried out by the critical illumination method.
[0061] While the light of a lamp is reflected in an incidence side within a glass rod while doing so the almost same effectiveness as the 1st operation gestalt mentioned above according to such 2nd operation gestalt, and equalizing, lighting without nonuniformity can be performed by reflecting in an outgoing radiation side the light transmitted with the fiber bundle 3 within a glass rod, and equalizing.
[0062] Furthermore, since critical illumination which carries out image formation of the outgoing radiation side of a glass rod to an outgoing radiation side on a display device is performed, the nonuniformity of the illumination light on a display device is cancelable.
[0063] In addition, as for this invention, it is needless to say for various deformation and application to be possible within limits which are not limited to the operation gestalt mentioned above and do not deviate from the main point of invention.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing the configuration of the image display device in the 1st operation gestalt of this invention.
[Drawing 2] The perspective view showing the example of 1 configuration of a lamp and a fiber bundle in the lighting system of the image display device of the operation gestalt of the above 1st.
[Drawing 3] The perspective view showing other examples of a configuration of a lamp and a fiber bundle in the lighting system of the image display device of the operation gestalt of the above 1st.
[Drawing 4] Drawing showing the situation of arrangement of the fiber in the configuration of above-mentioned drawing 3 .
[Drawing 5] Drawing showing the configuration of the incidence side optical system in the lighting system of the operation gestalt of the above 1st.
[Drawing 6] Drawing showing the configuration of the outgoing radiation side optical system in the lighting system of the operation gestalt of the above 1st.
[Drawing 7] Drawing showing the array of each fiber in the outgoing radiation edge of an outgoing radiation side subbundle in the operation gestalt of the above 1st.
[Drawing 8] Drawing showing the configuration of the incidence side optical system in the lighting system of the 2nd operation gestalt of this invention.
[Drawing 9] Drawing showing the configuration of the outgoing radiation side optical system in the lighting system of the operation gestalt of the above 2nd.
[Drawing 10] The perspective view showing the configuration of the glass rod arranged in the outgoing radiation side of a fiber bundle in the operation gestalt of the above 2nd.
[Description of Notations]
1 — Lamp unit
1a, 1b — Lamp (light source)
3 — Fiber bundle
3A — Outgoing radiation side subbundle
3B — Incidence side
3C — Incidence side subbundle
3a — Outgoing radiation edge
3b, 3c — Incidence edge
3f — Fiber
3 — Fiber bundle
5 — Display device
7 — Screen
7a — Partial image
7b — Superposition field
11 — Integrator lens (a lens array, incidence side optical system)
12 — Superposition lens (incidence side optical system)
13 — Condensing lens (incidence side optical system)

15 — Superposition lens (outgoing radiation side optical system)
16 — Condensing lens (outgoing radiation side optical system)
18 — Projection optics
22 25 — Glass rod
26 — The 1st lens
27 — The 2nd lens

[Translation done.]

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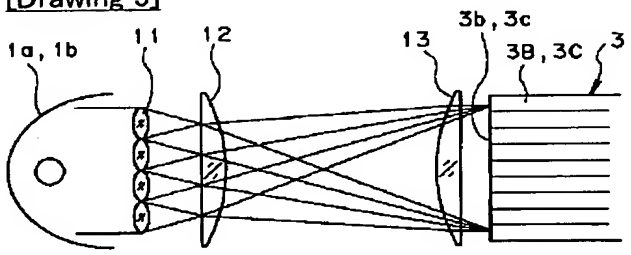
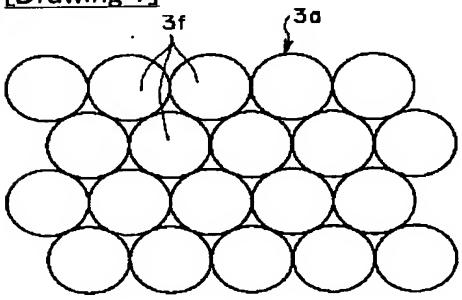
DRAWINGS

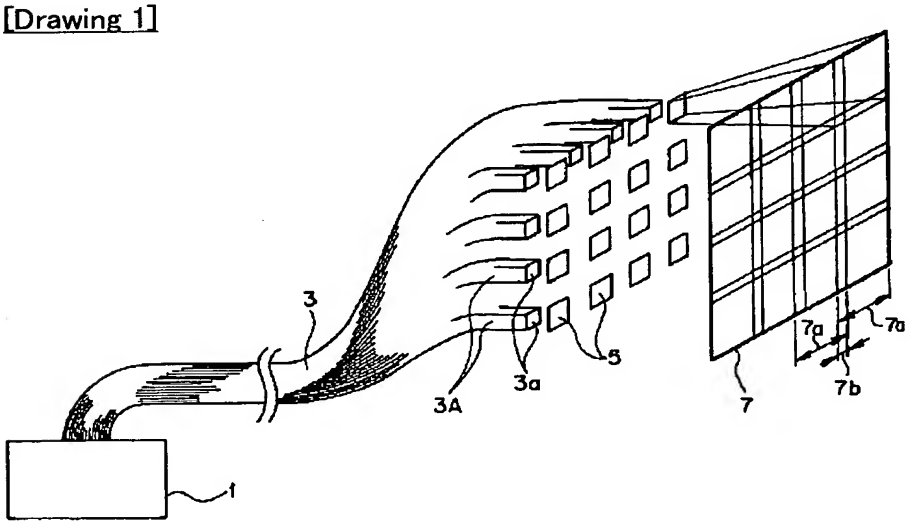
[Drawing 5]



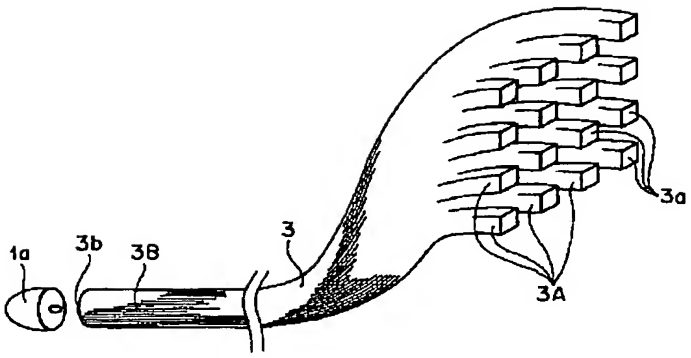
[Drawing 7]



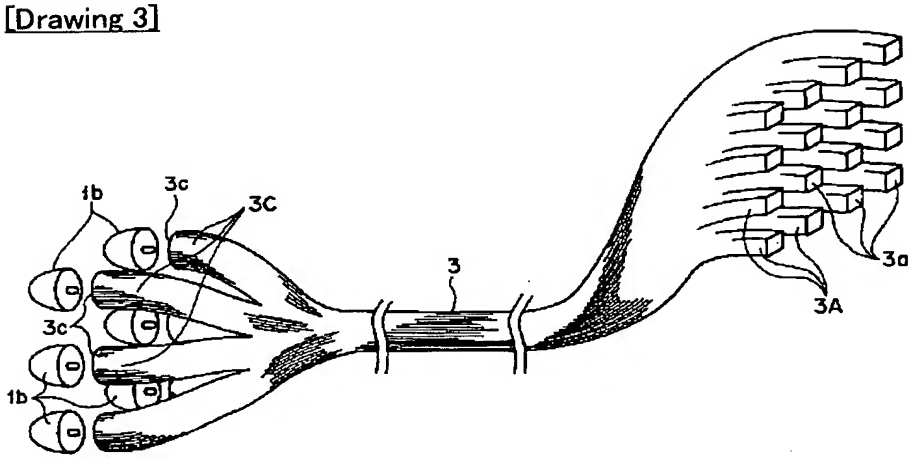
[Drawing 1]



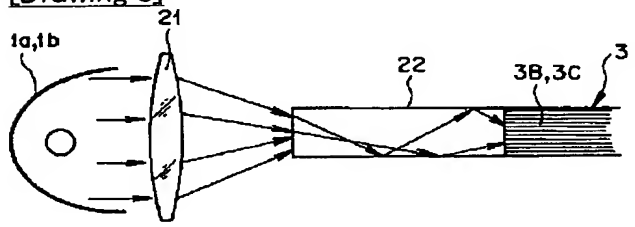
[Drawing 2]



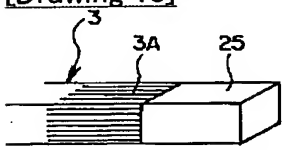
[Drawing 3]



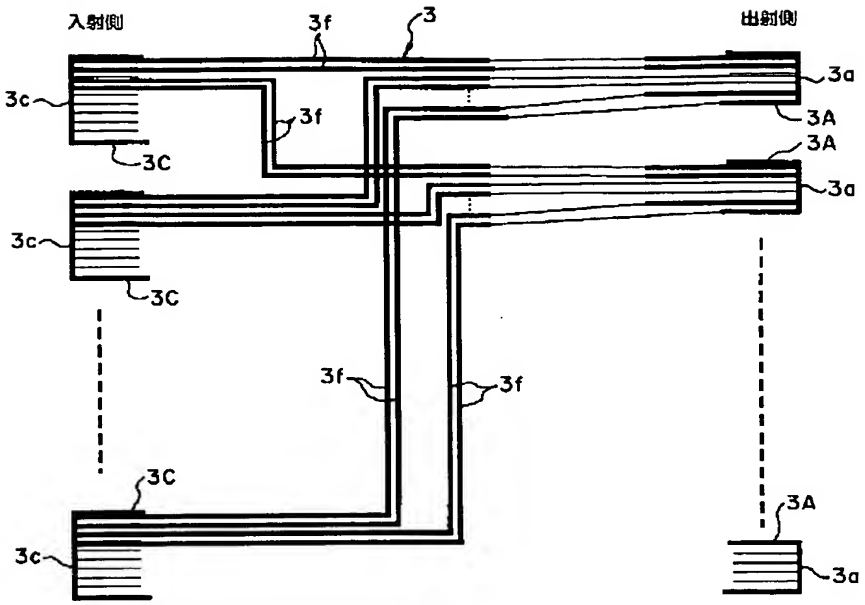
[Drawing 8]



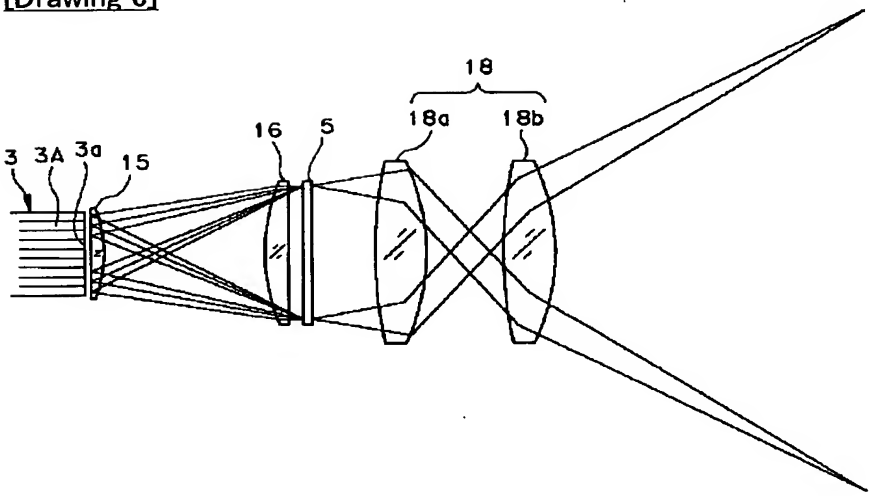
[Drawing 10]



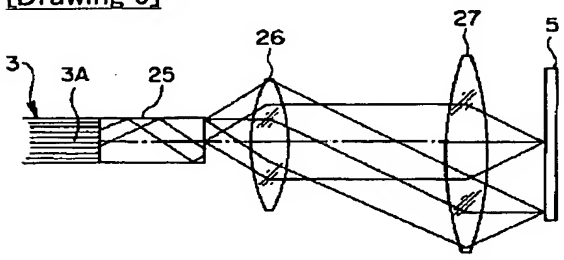
[Drawing 4]



[Drawing 6]



[Drawing 9]



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Ｇ０２Ｆ　1/13357		Ｇ０２Ｆ　1/13357		５Ｃ０９４
Ｇ０３Ｂ　21/00		Ｇ０３Ｂ　21/00	Ｅ	
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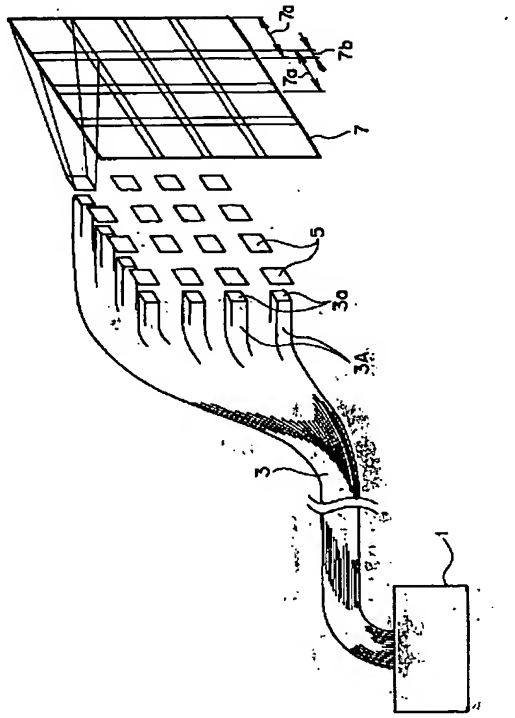
MA07
5C094 AA03 BA43 CA19 ED04

(54)【発明の名称】　画像表示装置

(57)【要約】
【課題】　各表示素子を均一に照明して高品質な画像を表示することができる画像表示装置を提供する。
【解決手段】　ｍ（ｍは２以上の整数）個の表示素子５を照明装置により照明して、その画像を投影光学系によりスクリーン７上に投影し、各画像を組み合わせることにより一画像を構成する画像表示装置であって、上記照明装置は、光源たるランプを収納するランプユニット１と、該ランプからの光を上記ｍ個の表示素子５に伝送するファイババンドル３と、を有してなり、該ファイババンドル３は、その出射側が、上記ｍ個の表示素子５に各対応したｍ束の出射側サブバンドル３Ａに分岐されて各々に出射端３ａが形成され、各出射端３ａから相対する各表示素子５に向けて照明光を照射する画像表示装置。



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【特許請求の範囲】

【請求項１】　ｍ（ｍは２以上の整数）個の表示素子と、これらの表示素子を照明する照明手段と、この照明手段により照明された表示素子の画像をスクリーン上に投影する投影光学系と、を具備し、上記ｍ個の表示素子による画像を組み合わせることにより一画像を構成する画像表示装置であって、

上記照明手段は、光源と、この光源からの光を上記ｍ個の表示素子に伝送するファイババンドルと、を有してなり、

該ファイババンドルは、その出射側において、上記ｍ個の表示素子に各対応したｍ束の出射側サブバンドルに分岐し、これらの出射側サブバンドルの各々に出射端が形成されたものであることを特徴とする画像表示装置。

【請求項２】　上記光源はｎ（ｎは２以上の整数）個設けられており、

上記ファイババンドルは、その入射側において、上記ｎ個の光源に各対応したｎ束の入射側サブバンドルに分岐し、これらの入射側サブバンドルの各々に入射端が形成されており、かつ、各入射側サブバンドルを構成するファイバは、上記ｍ束の出射側サブバンドルに均等に割り振られていることを特徴とする請求項１に記載の画像表示装置。

【請求項３】　上記ｍ束の出射側サブバンドルの出射端から上記ｍ個の表示素子に至るそれぞれの光路上には、該出射側サブバンドルを構成する各ファイバの出射端から出射される光を、上記表示素子の表示面全体に照射して重ね合わせるための出射側光学系が、各配置されていることを特徴とする請求項１に記載の画像表示装置。

【請求項４】　上記光源から入射側サブバンドルの入射端に至る光路上には、

上記光源の光から複数の２次光源像を形成するレンズアレイと、

これら複数の２次光源像から各々出射される光を、上記ファイババンドルの入射端の全面に照射して重ね合わせるための入射側光学系と、

が配置されていることを特徴とする請求項１に記載の画像表示装置。

【請求項５】　上記ファイババンドルは、その入射側と出射側との少なくとも一方に、該ファイババンドルと略同径のガラスロッドが配設されていることを特徴とする請求項２に記載の画像表示装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、画像表示装置、より詳しくは、複数の表示素子による画像を組み合わせることにより一画像を構成する画像表示装置に関する。

【０００２】

【従来の技術】複数の表示素子により部分画像を表示し、これらの部分画像をスクリーンに投影する際に、隣

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接する部分画像同士がその辺縁部において互いに重畳領域をもって重ね合わせられるように投影し、これら複数の部分画像を組み合わせることにより一画像を構成する画像表示装置は、従来より、種々のものが提案されている。

【０００３】このような画像表示装置の一例として、特開平９－２１１４１２号公報には、画像の一部を構成する部分画像を生成する複数の投写ユニットと、上記複数の投写ユニットから生成された部分画像を合成して表示するスクリーンとを備えたマルチ画像表示装置において、上記スクリーンは、複数の投写ユニットに対応して設けられた複数の部分フレネルレンズと、拡散素材を含んだ１枚の拡散板とで構成され、上記複数の部分フレネルレンズと、拡散板との間に一定長のスペースを設けたマルチ画像表示装置が記載されている。

【０００４】また、特開平９－１５９９８５号公報には、液晶パネルを備え画像の一部を構成する部分画像を生成する複数の液晶モジュールと、上記複数の液晶モジュールから生成された部分画像を表示するスクリーンと、上記複数の液晶モジュールの液晶パネルに対して光を供給する光供給部と、を有し、この光供給部が、複数の液晶モジュールに対して光を放出する少なくとも一つの光源と、この少なくとも一つの光源から放出された光を上記複数の液晶モジュールに分配する複数の光ファイバケーブルとを備えた画像表示システムが記載されている。

【０００５】

【発明が解決しようとする課題】このような画像表示装置は、上述したように、複数の表示素子による部分画像を組み合わせて一画像を構成するものであるために、スクリーン上に投影される各部分画像に輝度差や色の相違が発生することのないようにしなければならない。しかしながら、上記特開平９－２１１４１２号公報に記載されたような技術では、各表示素子毎に異なる照明光学部を用いているために、部分画像毎の輝度や色を均一に揃えるのは容易ではない。

【０００６】また、上記特開平９－１５９９８５号公報に記載されたような技術では、光ファイバに破損等が生じた場合に、表示素子への照明にムラが生じてしまう。

【０００７】そこでこうした均一な照明を、比較的低コストに実現することができる技術が望まれている。

【０００８】本発明は上記事情に鑑みてなされたものであり、各表示素子を均一に照明して高品質な画像を表示することができる画像表示装置を提供することを目的としている。

【０００９】

【課題を解決するための手段】上記の目的を達成するために、第１の発明による画像表示装置は、ｍ（ｍは２以上の整数）個の表示素子と、これらの表示素子を照明する照明手段と、この照明手段により照明された表示素子

の画像をスクリーン上に投影する投影光学系と、を具備し、上記m個の表示素子による画像を組み合わせることにより一画像を構成する画像表示装置であって、上記照明手段は、光源と、この光源からの光を上記m個の表示素子に伝送するファイババンドルと、を有してなり、該ファイババンドルは、その出射側において、上記m個の表示素子に各対応したm束の出射側サブバンドルに分岐し、これらの出射側サブバンドルの各々に出射端が形成されたものである。

【００１０】また、第２の発明による画像表示装置は、上記第１の発明による画像表示装置において、上記光源がｎ（ｎは２以上の整数）個設けられており、上記ファイババンドルは、その入射側において、上記ｎ個の光源に各対応したｎ束の入射側サブバンドルに分岐し、これらの入射側サブバンドルの各々に入射端が形成されており、かつ、各入射側サブバンドルを構成するファイバは、上記m束の出射側サブバンドルに均等に割り振られている。

【００１１】さらに、第３の発明による画像表示装置は、上記第１の発明による画像表示装置において、上記m束の出射側サブバンドルの出射端から上記m個の表示素子に至るそれぞれの光路上に、該出射側サブバンドルを構成する各ファイバの出射端から出射される光を、上記表示素子の表示面全体に照射して重ね合わせるための出射側光学系が、各配置されている。

【００１２】そして、第４の発明による画像表示装置は、上記第１の発明による画像表示装置において、上記光源から入射側サブバンドルの入射端に至る光路上に、上記光源の光から複数の２次光源像を形成するレンズアレイと、これら複数の２次光源像から各々出射される光を、上記ファイババンドルの入射端の全面に照射して重ね合わせるための入射側光学系と、が配置されている。

【００１３】加えて、第５の発明による画像表示装置は、上記第２の発明による画像表示装置において、上記ファイババンドルが、その入射側と出射側との少なくとも一方に、該ファイババンドルと略同径のガラスロッドが配設されたものである。

【００１４】

【発明の実施の形態】以下、図面を参照して本発明の実施の形態を説明する。図１から図７は本発明の第１の実施形態を示したものであり、図１は画像表示装置の構成を示す図、図２は画像表示装置の照明装置におけるランプとファイババンドルの一構成例を示す斜視図、図３は画像表示装置の照明装置におけるランプとファイババンドルの他の構成例を示す斜視図、図４は上記図３の構成におけるファイバの配置の様子を示す図、図５は照明装置における入射側光学系の構成を示す図、図６は照明装置における出射側光学系の構成を示す図、図７は出射側サブバンドルの出射端における各ファイバの配列を示す図である。

【００１５】この画像表示装置は、図１に示すように、ランプユニット１内で発光された光を、ファイババンドル３により伝送して、複数（この図１に示す例では１６個）の透過型ＬＣＤ等でなる表示素子５に照射し、該表示素子５による部分画像７ａをその辺縁部において互いに重畳領域７ｂを有するようにスクリーン７上に投影することで、全体として一画像を構成するものである。

【００１６】上記ファイババンドル３の一構成例について、図２を参照して説明する。

【００１７】この図２は、ランプユニット１内に光源たるランプ１ａが１つ配設されている場合の構成例である。

【００１８】ファイババンドル３は、複数のファイバ３ｆ（図４等参照）を束ねて構成されたものであり、入射側３Ｂの入射端３ｂから上記ランプ１ａの光を入射して、各ファイバ３ｆにより伝送するようになっている。

【００１９】該ファイババンドル３の出射側は、上記表示素子５の個数と同一数の出射側サブバンドル３Ａに分岐しており、各出射側サブバンドル３Ａには、均等な本数のファイバ３ｆが配置され、さらに、各出射側サブバンドル３Ａには伝送した光を出射するための出射端３ａがそれぞれ設けられている。

【００２０】このように構成することにより、同一のランプの光が分配されて各表示素子が照明されるために、照明の輝度や色のばらつきがなく、スクリーン７に投射された各部分画像により構成される一画像は、全体として統一されたものとなる。

【００２１】次に、上記ファイババンドル３の他の構成例について、図３を参照して説明する。

【００２２】この図３は、ランプユニット１内に光源たるランプ１ｂが複数配設されている場合の構成例である。

【００２３】ファイババンドル３の入射側は、ランプ１ｂの個数と同一数の入射側サブバンドル３Ｃに分岐しており、各入射側サブバンドル３Ｃには、均等な本数のファイバ３ｆが配置され、さらに、各入射側サブバンドル３Ｃには該ランプ１ｂからの光を入射するための入射端３ｃがそれぞれ設けられている。

【００２４】また、ファイババンドル３の出射側については、上記図２に示したものと同様である。

【００２５】この図３に示したようなファイババンドル３におけるファイバ３ｆの配置について、図４を参照してさらに説明する。

【００２６】上記ランプ１ｂの個数をｎ個（ｎは２以上の整数）、表示素子５の個数をｍ個（ｍは２以上の整数）とすると、入射側サブバンドル３Ｃはｎ束、出射側サブバンドル３Ａはｍ束、に各分岐していることになる。

【００２７】このとき、各入射側サブバンドル３Ｃが、ｐ本のファイバ３ｆにより構成されているとすると、こ

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れらは、ｐ／ｍずつに分岐されて、ｍ束設けられている出射側サブバンドル３Ａに各配分されている。

【００２８】こうして、全ての入射側サブバンドル３Ｃから入射される光が、各出射側サブバンドル３Ａに均等に割り振られて伝送され、何れの出射側サブバンドル３Ａからも同一の光量の光が出射されるように構成されている。

【００２９】このように構成することで、上記図２の構成で得られる効果にさらに加えて、複数のランプ１ｂの内の何れかが点灯しなくなったとしても、画像の一部のみが暗くなることはなく、画像全体の輝度がやや低下するだけの状態で画像の観察を引き続き行うことが可能となる。

【００３０】また、設計時にランプ１ｂの数を容易に変更することができるために、光量を所望に増減することが容易となり、単一のランプで大光量を得るのに比べて、ランプ自体の寿命を延ばすことも可能となる。

【００３１】次に、図５を参照して、照明手段としての照明装置における入射側光学系の構成について説明する。

【００３２】この図５に示す構成は、上記ランプ１ａからファイババンドル３の入射側３Ｂの入射端３ｂに至る光路上に配置された入射側光学系、またはランプ１ｂから入射側サブバンドル３Ｃの入射端３ｃに至る光路上に配置された入射側光学系の、何れにも適用されるものである。

【００３３】すなわち、上記ランプ１ａ，１ｂから出射された光は、格子状のレンズアレイでなるインテグレータレンズ１１に入射し、複数の２次光源像を形成するようになっている。

【００３４】この２次光源像は、重ね合わせレンズ１２およびコンデンサレンズ１３で構成されるケーラー照明光学系の入射側光学系により、ファイババンドル３の入射側３Ｂの入射端３ｂまたは入射側サブバンドル３Ｃの入射端３ｃに投射される。

【００３５】より詳しくは、複数の２次光源像のそれぞれから出射される光は、何れもが、入射端３ｂ，３ｃの全面に照射され、つまり、入射端３ｂ，３ｃに露呈している各ファイバ３ｆの全てに、全部の２次光源像からの光が重畳して照射されることになる。これにより、各ファイバ３ｆが伝送する光量は同一となるために、出射側において、ファイバ３ｆを個別に認識して配分する必要がなくなり、本数のみで配分することが可能となる。

【００３６】続いて、図６を参照して、照明手段としての照明装置における出射側光学系の構成について説明する。

【００３７】この図６に示す出射側光学系は、上記出射側サブバンドル３Ａの出射端３ａから表示素子５に至る光路上に配置されたものである。

【００３８】すなわち、出射側サブバンドル３Ａの出射

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端３ａから出射される光は、重ね合わせレンズ１５およびコンデンサレンズ１６で構成されるケーラー照明光学系の出射側光学系により、表示素子５の表示面全体に照射されるようになっている。これにより、表示素子５の表示面は、明暗の輝度分布が生じることなく、面全体を均一に照明される。

【００３９】こうして照明された表示素子５の画像は、レンズ１８ａとレンズ１８ｂで構成される投影光学系１８により、上記スクリーン７に向けて投影される。

【００４０】また、出射側サブバンドル３Ａの出射端３ａでは、各ファイバ３ｆは、図７に示すように配列されている。

【００４１】すなわち、矩形状を呈する表示素子５の表示面の形状に合わせて、全体の輪郭が略矩形状を呈するように複数本のファイバ３ｆが収束されているとともに、正三角形状の格子をなすように、ファイバ３ｆが配列されている。

【００４２】こうして、図７の水平方向に並ぶファイバ列は、偶数段と奇数段とで該水平方向の配列が半位相ずれるようになっている。複数の光源または２次光源像により表示素子５を照明し、該表示素子５から投射される部分画像の、重畳領域７ｂに係る光束を遮光板等を用いて遮光したときには、上記光源または２次光源像の配列に起因して、部分画像の辺縁部に階段状の輝度分布が発生する可能性があるが、この図７に示すような位相をずらした配列を行うことにより、該階段状の輝度分布を軽減して、円滑な輝度変化曲線を得られるようにしている。

【００４３】このような第１の実施形態によれば、ランプの光が各表示素子に均等に分配されるために、表示素子毎の輝度や色のばらつきが発生することはなく、高品質な画像を表示することが可能となる。

【００４４】また、入射側に複数のランプを配置する場合には、光量の増減を容易に調節することが可能となり、加えて、複数のランプの内の全部でない幾つかが点灯しなくなったとしても、画面に照明されない部分が発生することはない。

【００４５】さらに、各ファイバから出射される光が表示素子の表示面全体に照射されて、重ね合わせられるために、複数本のファイバの何れかに破損等が発生したとしても、表示素子の表示面上における輝度分布の不均一さが発生することはなく、表示面全体を一様に照明することが可能である。

【００４６】そして、ランプの光から複数の２次光源像を形成して、これら複数の２次光源像から各々出射される光を、ファイババンドルの入射端の全面に照射して重ね合わせるようしたために、ファイババンドルを構成する各ファイバに一様な光を入射させることができ、表示素子のより均一な照明が可能となる。

【００４７】図８から図１０は本発明の第２の実施形態

を示したものであり、図８は照明装置における入射側光学系の構成を示す図、図９は照明装置における出射側光学系の構成を示す図、図１０はファイババンドルの出射側に配設されたガラスロッドの構成を示す斜視図である。

【００４８】この第２の実施形態において、上述の第１の実施形態と同様である部分については同一の符号を付して説明を省略し、主として異なる点についてのみ説明する。

【００４９】この第２の実施形態の照明装置における入射側光学系は、図８に示すように構成されていて、ファイババンドル３の入射側に、光伝達方向に所定の長さを有するガラスロッド２２が配設されている。

【００５０】すなわち、上記ランプ１ａ，１ｂから出射された光は、レンズ２１によって集光されて、ガラスロッド２２に入射されるようになっている。

【００５１】この光は、該ガラスロッド２２の内部を通過するが、このとき光線の入射角に応じて内面で複数回の全反射が行われ、光線が混交されて光軸方向に垂直な面内の光強度が均一化された後に、ファイババンドル３に入射されるようになっている。

【００５２】このように、ガラスロッド２２を設けて、その内部で光線を多重反射させるようにしたために、ランプ１ａ，１ｂから出射される光の強度が、面内ムラなく平均化されて、ファイババンドル３の入射側３Ｂまたは入射側サブバンドル３Ｃを構成する個々のファイバに３ｆに同一の光量の光を入射させることができる。

【００５３】次に、本実施形態の照明装置における出射側光学系は、図９に示すように構成されていて、ファイババンドル３の出射側に、光伝達方向に所定の長さを有するガラスロッド２５が配設されている。

【００５４】ここで、上記ガラスロッド２５は、図１０に示すように、複数本のファイバ３ｆを略矩形状に収束してなる出射側サブバンドル３Ａの形状に合わせて、該出射側サブバンドル３Ａと略同径の、直方体形状に形成されている。

【００５５】このような構成において、ファイババンドル３を伝送されてきた光は、続くガラスロッド２５に入射されるが、このとき光線の入射角に応じて内面で複数回の全反射が行われ、光線が混交されて光軸方向に垂直な面内の光強度が均一化された後に、出射されるようになっている。

【００５６】このように、ガラスロッド２５を設けて、その内部で光線を多重反射させるようにしたために、ファイババンドル３を伝送された光の出射方向に垂直な面内における光強度のムラを平均化して出射することができる。

【００５７】従って、入射側での複数のランプ１ｂ同士の輝度の違いやランプ１ａ，１ｂ自体の輝度分布の違い、あるいはファイババンドル３を構成するファイバ３ｆの折れ、等に起因する光強度の面内ムラを排除することができる。

【００５８】上記ガラスロッド２５から出射された光は、その後に、第１のレンズ２６と第２のレンズ２７によって、表示素子５に照射される。ここで、これら第１のレンズ２６と第２のレンズ２７は、上記ガラスロッド２５の出射面を表示素子５上に結像させるような照明光学系を構成している（クリティカル照明）。

【００５９】この照明法により、ファイババンドル３から出射される光の強度の角度分布に生じ得るムラを、表示素子５上における面内ムラに変換させることなく、一様に照明することができる。

【００６０】こうして、ファイババンドル３の光の面内強度ムラを、ガラスロッド２５を用いることにより除去してから、出射される光の角度分布における強度ムラを、第１のレンズ２６と第２のレンズ２７でなる照明光学系によりクリティカル照明法で除去するようになっている。

【００６１】このような第２の実施形態によれば、上述した第１の実施形態とほぼ同様の効果を奏するとともに、ランプの光を入射側においてガラスロッド内で反射させて均一化するとともに、ファイババンドル３で伝送された光を出射側においてガラスロッド内で反射させて均一化することにより、ムラのない照明を行うことができる。

【００６２】さらに、出射側において、ガラスロッドの出射面を表示素子上に結像させるクリティカル照明を行っているために、表示素子上における照明光のムラを解消することができる。

【００６３】なお、本発明は上述した実施形態に限定されるものではなく、発明の主旨を逸脱しない範囲内において種々の変形や応用が可能であることは勿論である。

【００６４】

【発明の効果】以上説明したように請求項１による本発明の画像表示装置によれば、ファイババンドルの出射側を、ｍ個の表示素子に各対応したｍ束の出射側サブバンドルに分岐させ、これらの出射側サブバンドルの各々に出射端を形成したために、各表示素子を、輝度や色のばらつきなく均一に照明して、高品質な画像を表示することが可能となる。

【００６５】また、請求項２による本発明の画像表示装置によれば、請求項１に記載の発明と同様の効果を奏するとともに、ファイババンドルの入射側を、ｎ個の光源に各対応したｎ束の入射側サブバンドルに分岐させ、これらの入射側サブバンドルの各々に入射端を形成するとともに、各入射側サブバンドルを構成するファイバを、上記ｍ束の出射側サブバンドルに均等に割り振ったために、光量を容易に増加させることが可能であり、また、ｎ個の光源の内の一つまたは全部でない複数が消えたとしても、画面に非照明部分が発生することはなく、画像

の観察を継続することができる。

【００６６】さらに、請求項３による本発明の画像表示装置によれば、請求項１に記載の発明と同様の効果を奏するとともに、出射側サブバンドルを構成する各ファイバの出射端から出射される光を、表示素子の表示面全体に照射して重ね合わせるための出射側光学系を設けたために、ファイバの破損等が発生したとしても、表示素子面上での輝度分布を一様に維持することができる。

【００６７】そして、請求項４による本発明の画像表示装置によれば、請求項１に記載の発明と同様の効果を奏するとともに、光源の光から複数の２次光源像を形成するレンズアレイと、これら複数の２次光源像から各々出射される光をファイババンドルの入射端の全面に照射して重ね合わせるための入射側光学系と、を設けたために、ファイババンドルに一様な光を入射させることが可能となる。

【００６８】加えて、請求項５による本発明の画像表示装置によれば、請求項２に記載の発明と同様の効果を奏するとともに、照明手段からの光の強度の面内ムラが平均化されるために、ファイババンドルの個々のファイバに同一の光量の光を入射させることができる。また、ファイババンドルからの光の強度の面内ムラが平均化されるために、個々の表示素子に同一の光量の光を入射させることができる。

【図面の簡単な説明】

【図１】本発明の第１の実施形態における画像表示装置の構成を示す図。

【図２】上記第１の実施形態の画像表示装置の照明装置におけるランプとファイババンドルの一構成例を示す斜視図。

【図３】上記第１の実施形態の画像表示装置の照明装置におけるランプとファイババンドルの他の構成例を示す斜視図。

【図４】上記図３の構成におけるファイバの配置の様子を示す図。

【図５】上記第１の実施形態の照明装置における入射側光学系の構成を示す図。

【図６】上記第１の実施形態の照明装置における出射側光学系の構成を示す図。

【図７】上記第１の実施形態において、出射側サブバンドルの出射端における各ファイバの配列を示す図。

【図８】本発明の第２の実施形態の照明装置における入射側光学系の構成を示す図。

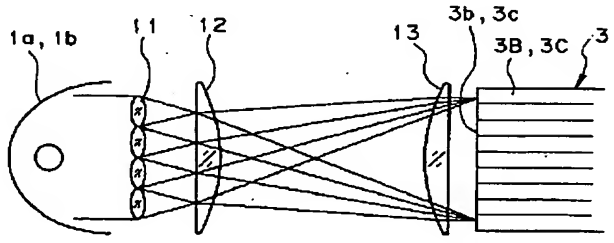
【図９】上記第２の実施形態の照明装置における出射側光学系の構成を示す図。

【図１０】上記第２の実施形態において、ファイババンドルの出射側に配設されたガラスロッドの構成を示す斜視図。

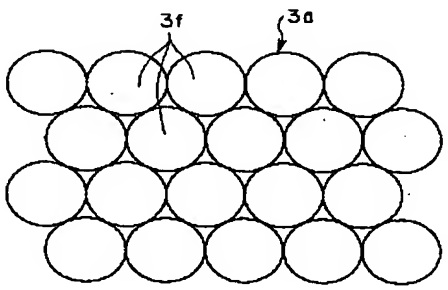
【符号の説明】

１…ランプユニット
１ａ，１ｂ…ランプ（光源）
３…ファイババンドル
３Ａ…出射側サブバンドル
３Ｂ…入射側
３Ｃ…入射側サブバンドル
３ａ…出射端
３ｂ，３ｃ…入射端
３ｆ…ファイバ
３…ファイババンドル
５…表示素子
７…スクリーン
７ａ…部分画像
７ｂ…重畳領域
１１…インテグレータレンズ（レンズアレイ、入射側光学系）
１２…重ね合わせレンズ（入射側光学系）
１３…コンデンサレンズ（入射側光学系）
１５…重ね合わせレンズ（出射側光学系）
１６…コンデンサレンズ（出射側光学系）
１８…投影光学系
２２，２５…ガラスロッド
２６…第１のレンズ
２７…第２のレンズ

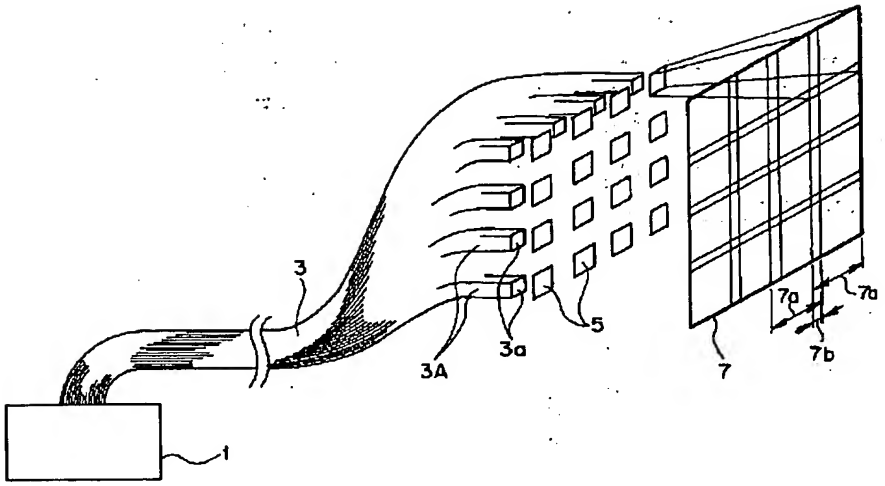
【図５】



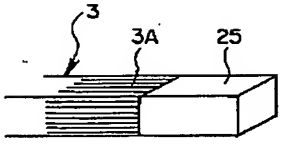
【図７】



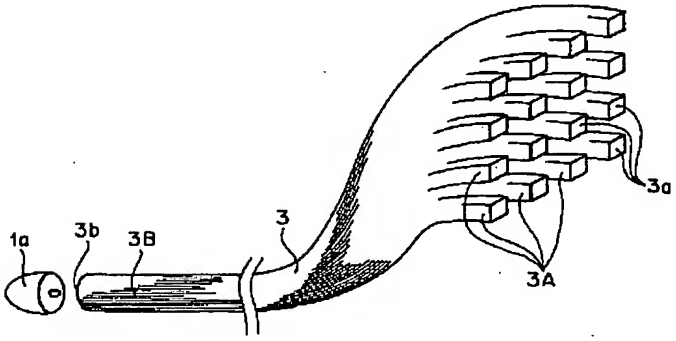
【図１】



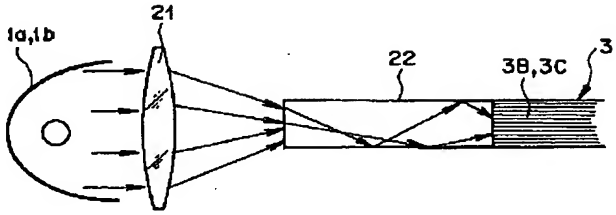
【図１０】



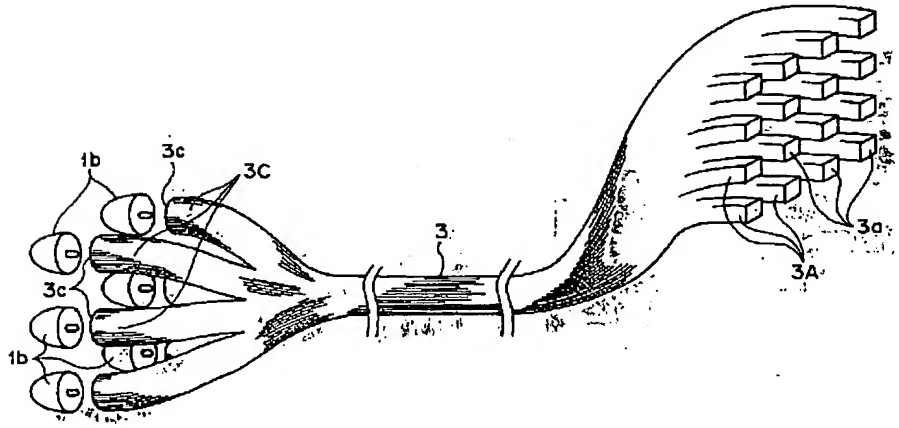
【図２】



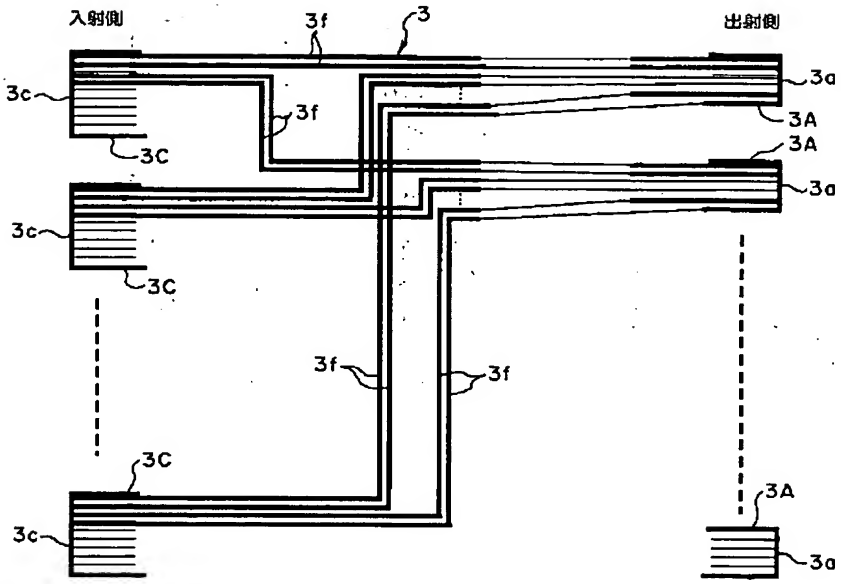
【図８】



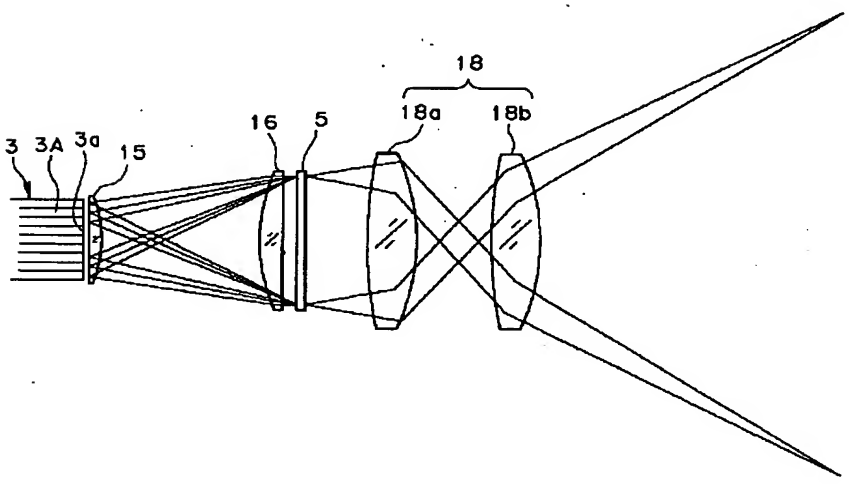
【図３】



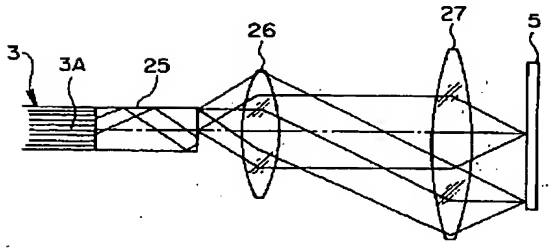
【図４】


入射側
3f
3
出射側
3a
3c
3f
3A
3C
3A
3a
3c
3C
3f
3f
3C
3A
3c
3a

【図６】


18
18a
18b
16
5
3
3A
3a
15

【図９】


3
3A
25
26
27
5